Yield and Quality of Wheat Varieties under Different Levels and Methods of Zinc Application

Shiva Dhar[1], R. K. Rai[2], Anju M. Singh[3] and G. P. Singh[4]

[1, 2] Division of Agronomy, Indian Agricultural Research Institute, New Delhi-110 012, INDIA (drsdmisra@gmail.com)
[3] Division of Genetics, Indian Agricultural Research Institute, New Delhi-110 012, INDIA (anju_mahendru@yahoo.co.in)
[4] Division of Genetics, Indian Agricultural Research Institute, New Delhi-110 012, INDIA (dwrpratap@gmail.com)

INTRODUCTION

Zinc deficiency is widely reported in most of the Indian soils. The problem of Zn deficiency is more serious in rice-wheat system of Indo-Gangetic plains due to mining of micronutrients and application of high value fertilizers specifically nitrogen, phosphorus and potassium. Several reports are indicating significant response of rice and wheat crops in the form of productivity and grain quality with the application of Zn in soil or foliar spray. The response of genotypes to applied Zn in terms of grain yield and the concentration of Zn in grain and other parts of plants in wheat is not well-studied. There is an urgent need to estimate the effect of various doses and methods of applied Zn on grain Zn concentration and grain yield of popular wheat varieties. The aims of the present study were to assess suitability of various doses of soil applied Zn and different methods and rates of foliar sprays of Zn on grain yield and grain concentration of Zn.

METHODS

An experiment was conducted during *rabi* seasons of 2005-06 to 2006-07 at Research Farm, Indian Agricultural Research Institute, New Delhi to assess the response of popular wheat varieties to different doses and methods of Zn application. Experiment was laid out in split plot design keeping six Zn treatments in main plots as following: i) control-no zinc either soil or foliar, ii) soil applied pre-plant and well incorporated in the soil at 25 kg of $ZnSO_4$ ha^{-1}, iii) soil applied pre-plant and well incorporated in the soil at 50 kg of $ZnSO_4$ ha^{-1}, iv) no soil applied Zn with a foliar application at a rate of 2.0 kg of $ZnSO_4$ ha^{-1} at boot stage and one week after anthesis, v) soil applied pre-plant and well incorporated in the soil at 25 kg of $ZnSO_4$ ha^{-1} + 2 foliar applications one at the boot stage and the other one week after anthesis at a rate of 2.0 kg of $ZnSO_4$ ha^{-1} each, and vi) two foliar applications one at the boot stage and the other one week after anthesis at a rate of % 0.2 $ZnSO_4$ each until all leaves are totally wet). In the experiment three wheat varieties ('PBW 175', 'HD 2687' and 'HD 2733') in subplots with three replications were used. The foliar applications were made between 4.00 to 5.00 PM. The gross and net plot size were kept 3.15×4.0 m^2 and 2.25×3.0 m^2, respectively. An uniform dose of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1} was applied to all the treatments. Before the main harvest 10 random heads from the plot had plucked off and placed in clean paper envelopes and heads were threshed by hand and seed were stored in paper envelopes and anaysed by using AAS for Zn and Fe concentration in grains.

RESULTS AND DISCUSSION

Among different varieties 'HD 2687' exhibited significantly higher grain yield (Table 1) and 1000 grain weight over other varieties while straw yield and grains ear $head^{-1}$ obtained from 'HD 2733' and 'PBW 175' were on par with each other. Number of fertile tillers, grains/ear head, 1000-grain weight and straw yields were found significantly superior in Zn applied treatments as compared to the control treatment. Application of Zn through various methods, except soil applied 25 kg $ZnSO_4$ ha^{-1}, produced significantly higher grain yield as compared to control (no Zn). Two foliar spray of 0.2

% $ZnSO_4$ solution, until all leaves are totally wet, at boot stage and one week after anthesis resulted in significantly higher fertile tillers m^2, grains ear $head^{-1}$, grain and straw yields over other treatments. However, 1000 grain weight of this treatment was at par with soil applied 25 kg $ZnSO_4$ ha^{-1} + two foliar spray at boot stage and after anthesis at a rate of 2 kg $ZnSO_4$ ha^{-1} each. Highest Zn and Fe concentration in grain were recorded in the 'HD 2687' as compared to 'HD 2733' and 'PBW 175'(Table 1). Among various methods and doses of Zn application Fe concentration in grains was higher in untreated plot and where $ZnSO_4$ was applied as foliar spray. Soil applied heavy doses of $ZnSO_4$ had a slight reducing effect on grain Fe concentration. Imtiaz *et al.* (2003) also reported adverse effect of Zn application on Fe concentration and Fe uptake in plant. Relatively higher Zn concentration in grains was recorded when $ZnSO_4$ was applied as foliar spray or combination of soil application because wheat is able to translocate foliar-applied Zn from stem and leaves into developing grain (Pearson *et al*., 1996). The soil applied $ZnSO_4$ at lower doses was not found as effective as foliar applied Zn with respect to Zn concentration in grain. Zn concentration in grains was considerably lower when it is applied to soil as compared to foliar spray.

Table 1. Effect of different levels and methods of Zn application on yield and conentration of Fe and Zn in grains of wheat varieties

Treatments	Grain yield ($t\ ha^{-1}$)	Straw yield ($t\ ha^{-1}$)	Fe ($mg\ kg^{-1}$)	Zn ($mg\ kg^{-1}$)
Varieties				
'PBW 175'	4.16	7.11	33.24	43.74
'HD 2687'	4.31	7.50	35.95	48.32
'HD 2733'	3.85	6.95	33.20	43.95
LSD (P=0.05)	0.09	0.23	-	-
Zn application				
No Zn (Control)	3.94	6.66	35.23	41.09
Soil applied 25 kg $ZnSO_4$ /ha	3.99	6.85	32.83	43.78
Soil applied 50 kg $ZnSO_4$ /ha	4.09	7.13	32.30	44.50
Foliar 2.0 kg $ZnSO_4$/ha at boot and after anthesis	4.08	7.20	34.14	47.27
Soil applied 25 kg $ZnSO_4$ /ha + 2 foliar spray at boot and other after anthesis @ 2.0 kg $ZnSO_4$/ha each	4.21	7.55	34.62	47.54
2 foliar spray at boot and after anthesis @ 0.2 % $ZnSO_4$ each until all leaves are totally wet	4.32	7.74	35.66	47.83
LSD (P=0.05)	0.06	0.19	-	-

CONCLUSIONS

Based on the above findings wheat variety 'HD 2687' was found to be more responsive to Zn application and produced higher yield with higher concentration of Zn and Fe in grains in comparison with other varieties. Soil applied 25 kg $ZnSO_4$ /ha + 2 foliar spray at boot and after anthesis @ 2.0 kg $ZnSO_4$/ha each or 2 foliar spray at boot and after anthesis @ 0.2 % $ZnSO_4$ each until all leaves are totally wet produced higher grain yield and Zn and Fe concentration in grains. These treatments performed better than soil applied 50 kg $ZnSO_4$ /ha.

REFERENCES

Imtiaz, M., Alloway, B.J., Shah, K.H., Siddiqui, S.H., Memon, M.Y., Aslam, M. and Khan, P. (2003) Zinc nutrition of Wheat: II: Interaction of zinc with other trace elements. *Asian Journal of Plant Sciences* 2(2): 156-160

Pearson, J.N., Rengel, Z., Jenner, C.F. and Graham, R.D. (1996) Manipulation of xylem transport affects Zn and Mn transport into developing wheat grains of cultured ears. *Physiologia Plantarum* 98: 229-234